DESCRIPTION

ARTIFICIAL HAIR

Technical Field

The present invention relates to artificial hair whose look and feel both are close in character to that of natural human hair, and which holds that character with the passage of time.

Background Art

Synthetic fiber materials such as polyester, acrylic, vinyl chloride, and nylon have traditionally been employed for artificial hair used in wigs, toupees, and the like. For example, by mixing together polyethylene terephthalate and polybutylene terephthalate, an attempt has been made to improve the texture (Japanese Unexamined Pat. App. Pub. No. 2002-161423). In another example, toward improving the texture of artificial hair and ease of handling when braiding or doing similar handiwork, polyethylene terephthalate has been spun into flat, even fibers and yarns for artificial hair (Japanese Unexamined Pat. App. Pub. No. H09-132813).

When wigs employing artificial hair materials such as noted above are worn and the wearer goes about his or her daily routine, as hair the material takes on an unnatural frizziness and gloss peculiar to synthetic fibers. What happens as a result is that the natural feeling of the artificial hair as a replacement, given forth by its texture and other properties, is spoiled, compromising its value as a wig.

Disclosure of Invention

The present inventors overcame the problems discussed above by using poly(trimethylene terephthalate) in monofilaments.

In particular, the tasks for the present invention are accomplished by:

(1) Artificial hair composed of monofilaments containing poly(trimethylene terephthalate); and

(2) Artificial hair set forth in (1), being monofilaments having a denier of 22 to 333 decitex, a melting point of 225 to 235°C, and a glass transition temperature of 45 to 80°C; or by

(3) A method of manufacturing artificial hair, characterized in that in manufacturing artificial-hair monofilaments from a polymer containing poly(trimethylene terephthalate), the melt-spinning temperature at which the polymer containing poly(trimethylene terephthalate) spins is 240 to 320°C;

(4) An artificial-hair manufacturing method as set forth in (3), characterized in that the draw ratio when the monofilaments are extruded is 2.0 to 4.0 times; and

(5) An artificial-hair manufacturing method as set forth in (4), characterized in that the temperature in extruding the monofilaments is 35 to 100°C in the draw zone.

Artificial hair of the present invention in terms of its physical properties of elastic recovery, strength, stretch, and texture resembles natural human hair; moreover, its high resiliency enables the artificial hair to keep from becoming glossy due to frizzes and kinks.

Best Mode for Carrying Out the Invention

Poly(trimethylene terephthalate) included in the present invention may be poly(trimethylene terephthalate) alone, or may be the copolymers of poly(trimethylene terephthalate) set forth below. Namely, as to the substances for copolymerization with poly(trimethylene terephthalate), an acid component—such as isophthalic acid, succinic acid, adipic acid, or 2,6-naphthalene dicarboxylic acid—a glycol component—such as 1,4-butanediol, 1,6-hexanediol, or cylcohexanedimethanol—or ε-caprolactam, 4-hydroxybenzoic acid, polyoxyethylene glycol, polytetramethylene glycol, etc. may be copolymerized as long as they do not compromise the effectiveness of the present invention, and may be copolymerized in an amount less than 10 wt.%.

In addition, the poly(trimethylene terephthalate) or copolymer thereof may be, according to requirements, copolymerized or mixed with various additives, such as deglossers, heat stabilizers, defoamers, toners, flame retardants, antioxidants, ultraviolet absorbers, infrared absorbers, crystallizers, and fluorescent brighteners, for example.

The polymer constituting poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention can be polymerized using a publicly known method. For example, the polymer can be produced by transesterifying terephthalic acid, or an ester of terephthalic acid and a primary alcohol, with an abundance of 1,3-propanediol in the presence of tetrabutyl titanate or a similar catalyst, and subsequently adding tetrabutyl titanate or a like catalyst to the obtained reactant and subjecting the combination to a polycondensation reaction at 240 to 280°C under a vacuum of 0.5 torr or lower. Monofilaments can then be manufactured from the obtained polymer by a routine spinning method.

The molecular weight of the polymer constituting poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention is defined according to intrinsic viscosity measured by the method set forth under Embodiments. The intrinsic viscosity [η] is ordinarily 0.4 to 2.0, preferably 0.5 to 1.5, more preferably 0.6 to 1.2. When the intrinsic viscosity is 0.4 or more, the spinability of the polymer stabilizes owing to its high melt viscosity. Conversely, when the intrinsic viscosity is 2.0 or less, because the melt viscosity is not overly high, metering with the gear pump goes smoothly, such that there is no detriment to the spinability due to improper discharge or other polymer flow problems.

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention preferably have a monofilament denier of 22 to 333 decitex (dtex). Furthermore, a denier of 40 to 250 dtex, or further still, of 50 to 200 dtex, makes it possible to gain an appearance and touch close to that of natural human hair.

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention ideally have a melting point of 225 to 235°C, more preferably, 228 to 232°C. This is because the narrower the melting-point temperature range with respect to the spinning temperature is, the more the processing characteristics will improve.

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention ideally have a glass transition temperature (shortened to *Tg* hereinafter) of 45 to 80°C. Since the *Tg* corresponds to the molecular density of the filament amorphous portion, the smaller this value is, the smaller will be the molecular density of the amorphous portion, owing to which the molecules will function more readily. As long as the *Tg* does not exceed 80°C, the fibers will not

become overly stiff, allowing the fibers to be set as hair. As long as the *Tg* is not less than 45°C, the texture of the fibers as hair will not be spoiled. From the perspective of good balance to the fibers as hair, the *Tg* is preferably 45 to 70°C, more preferably 55 to 65°C.

Inasmuch as the *Tg* is thus a structural factor in a fiber, polymers possessing the same molecular structure will nonetheless exhibit different *Tg* values depending on the spinning conditions, including spinning temperature, spinning speed, draw ratio, and temperature when drawing.

The cross-sectional form of poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention is not particularly limited and may be, to give examples, round, triangular, square or pentagonal; or the filaments may be flat.

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention are manufacturable by publicly known methods. Namely, the monofilaments are manufacturable for example by a method in which polymer is extruded through a nozzle, cold-hardened using cooling water, and then wrapped several times onto a roll spun at uniform speed, whereupon drawing is carried out between a first roll and a second roll installed succeeding the first roll so that absolutely no tension is transmitted before and after the roll, and thereafter the drawn filament is spooled with a winder.

The spinning temperature when melt-spinning the polymer of the monofilaments is suitably 240 to 320°C, preferably 245 to 300°C, more preferably 250 to 280°C. Stabilized fluidity is obtained with a spinning temperature of 240°C or more, the spinability is not compromised, and a satisfying strength is demonstrated. With a spinning temperature of no greater than 320°C, thermal decomposition is

not severe, there is no discoloring of the obtained filament, and a satisfying strength is demonstrated.

As to the speed at which the filament is spooled, ordinarily it is spooled at 1500 m/min or less, preferably 500 m/min or less, more preferably 400 m/min or less. Cooling is facilitated when the spooling speed is no greater than 1500 m/min.

A satisfactory draw ratio for the drawing operation is 2.0 to 4.0 times, preferably 2.2 to 3.7 times, more preferably 2.5 to 3.5 times. With a draw ratio of 2.0 times or greater, the polymer can adequately be oriented by the drawing operation, such that the strength of the obtained filament is unlikely to prove to be low. Likewise, with a draw ratio of no greater than 4.0 times, the filament is kept from breaking, which enables a stable drawing operation to be carried out.

A satisfactory temperature when drawing is 35 to 100°C in the draw zone, preferably 40 to 100°C, more preferably 50 to 100°C. With a draw-zone temperature of 35°C or more, filament breakage when drawing is minimal, such that a continuous monofilament can be produced. Likewise, as long as the temperature is no greater than 100°C, the smoothness of the draw rolls etc. for the fiber with respect to the heating zone will not deteriorate, such that filament breakage is minimal. Furthermore, the obtained filament may according to requirements be put through a 120 to 180°C thermosetting process.

Embodiments

While embodiments will be given below to describe the present invention more specifically, inasmuch as the embodiments are only exemplary, the present invention is of course not thereby limited. It is also to be noted that the principal measurements in the embodiments were determined by the following methods.

(1) Intrinsic Viscosity

Determined by a measurement technique using an Ostwald viscometer on polymer at 1% concentration and 35°C in ortho-chlorophenol as a solvent.

(2) Glass Transition Temperature

Measured within dry nitrogen at a ramp-up speed of 20°C/min, utilizing the Exstar-6000, a differential scanning calorimeter manufactured by Seiko Instruments, Inc.

(3) Elastic Recovery

A 200-gram weight was hung on a 100-centimeter-length sample for 24 hours, following which the sample was freed and after 1 hour its length measured.

The elastic recovery as a percentage of that of natural human hair was 85% according to this technique.

(4) Texture Comparison

The texture of the artificial hair was compared visually with that of natural human hair.

◎: Texture extraordinarily close to that of natural human hair

○: Texture close to that of natural human hair

△: Could tell that it is not natural human hair

×: Could clearly tell that it is not natural human hair

Embodiments 1 through 3

Melt extrusion employing poly(trimethylene terephthalate)—intrinsic viscosity 0.85—was carried out at a 270°C spinning temperature, and filaments were spun at a draw ratio of 2.5 times, at a temperature in the draw zone of 70°C in

Embodiments 1 and 2, and of 80°C in Embodiment 3. Monofilaments having deniers of 55, 111 and 222 dtex were spun. The results of the evaluations done on the obtained monofilaments are set forth in Table One. The obtained monofilaments had a *Tg* of 55°C, yielded elastic recovery results near that of natural human hair, and in the comparison with natural human hair, yielded a texture very close to that of natural human hair. What is more, that texture held with the elapse of time.

Embodiments 4 through 6

Melt extrusion employing poly(trimethylene terephthalate) was carried out at a 270°C spinning temperature, and filaments were spun at a draw ratio of 3.5 times, at a temperature in the draw zone of 80°C in Embodiments 4 and 5, and of 100°C in Embodiment 6. Monofilaments having deniers of 55, 111 and 222 dtex were spun. The results of the evaluations done on the obtained monofilaments are set forth in Table One. The obtained monofilaments had a *Tg* of 65°C, yielded elastic recovery results near that of natural human hair, and in the comparison with natural human hair, yielded a texture very close to that of natural human hair. What is more, that texture held with the elapse of time.

Table One

	Raw thread material	Denier (D)	Melting point (°C)	*Tg* (°C)	Elastic recovery (%)	Comparison with natural human hair
Embod. 1	PTT	50	230	55	80	◎
Embod. 2	PTT	100	230	55	80	◎
Embod. 3	PTT	200	230	55	80	◎
Embod. 4	PTT	50	230	65	80	◎
Embod. 5	PTT	100	230	65	80	◎
Embod. 6	PTT	200	230	65	80	◎

Comparative Examples 1 through 8

Polyethylene terephthalate (PET), nylon (Ny), acrylic (AN), and polyvinyl chloride (PVC) were spun into filaments that were evaluated in the same way. The results are set forth in Table Two.

With the comparative examples, in whichever case the elastic recovery was low, nor could a texture near that of natural human hair be obtained.

Table Two

	Raw thread material	Denier (D)	Melting point (°C)	*Tg* (°C)	Elastic recovery (%)	Comparison with natural human hair
Comp. Ex. 1	PET	50	254	68	32	△
Comp. Ex. 2	PET	100	254	68	32	△
Comp. Ex. 3	Ny	50	220	47	65	△
Comp. Ex. 4	Ny	100	220	47	65	△
Comp. Ex. 5	AN	50	–	unclear	40	△
Comp. Ex. 6	AN	100	–	unclear	40	△
Comp. Ex. 7	PVC	50	210	82	30	×
Comp. Ex. 8	PVC	100	210	82	30	×

Industrial Applicability

When utilized in artificial hair, poly(trimethylene terephthalate)-containing monofilaments of the present invention, compared with artificial hair composed of polyamide fibers, polyester fibers, acrylic fibers, or similar publicly known fibers, markedly improve the look, feel, and similar characteristics. Accordingly, artificial hair composed of poly(trimethylene terephthalate)-containing monofilaments of the present invention is extremely serviceable.